Project-14

Project Proposal

Title: A study on sympatric carnivores (tiger, leopard and wild dog) in Mudumalai Tiger Reserve, Tamil Nadu, India.

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Collaborating Agencies	:	Tamil Nadu Forest Department
Study Area	:	Mudumalai Tiger, Tamil Nadu
Time required for initiating the proposed study	:	As soon as the project is approved.
Project duration	:	3 Years
Total cost	:	34,47,040 or US$ 82072 **(Rupees Thirty Four Lakhs Forty Seven Thousand Forty only)**

Research Priority Matrix, WII	:	Western Ghats & Endangered Species ecology and Management
Research Development Plan WII	:	5.1 Monitoring carnivores, prey populations and habitats. 5.6 State of the Wildlife Report

Project Peer Reviewed by :

National Reviewers:

1. Jamal A. Khan, Reader, AMU, Aligarh
2.

International Reviewers:

3. Dr. Peter Jackson, Chairman Emeritas, IUCN, Cat Specialist Group
4. Dr. Urs Breitenmoser, Co-Chairman, IUCN/SSC, Cat Specialist Group

Consent from State Forest Dept. : Will be procured once the project is approved by the TRAC.

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A study on sympatric carnivores (tiger, leopard and wild dog) in Mudumalai Tiger Reserve, Tamil Nadu, India.

Abstract

The proposed study aims to collect information on the status, distribution, population, food habits and prey availability of sympatric carnivores such as tiger (*Panthera tigris)*, leopard (*P. pardus)* and dhole *(Cuon alpinus)* in Mudumalai Tiger Reserve located in the Western Ghats of south India over a period of three years. Information on density, distribution, group size and composition of prey species of sympatric carnivores will be collected using line transect technique. The food habits of large carnivores including prey selection will be determined from analyses of scats and kills. Selectivity for prey species will be inferred from likelihood ratio tests comparing observed scats to hypothesized scat frequencies generated from prey density estimates using parametric bootstrap simulations. Predator selectivity for size, age, sex and physical condition of prey will be estimated using selection of indices. The large carnivore population will be estimated using camera traps. The outcome of the proposed study would reveal information on the sympatric carnivore's status, distribution, population, availability of prey species, habitat use, and food habits which in turn will make us understand their ecological separation. The GIS map outputs that will be generated on sympatric carnivores and their prey species distribution with specific reference to anthropogenic pressure zones will be of immense use for the park management to effectively manage the habitats for tiger, leopard and wild dogs in Mudumalai Tiger Reserve and surrounding areas.

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1. Introduction

Differences among sympatric species with respect to use of tropic, temporal, and spatial aspects of their environments have frequently been used to clarify how the component species coexist. Segregation along one or more of these niche dimensions facilitates partitioning of resources and thereby the ecological separation of species (Karanth and Sunquist 2000). Whether the separation is causally related to competitive interactions, due to stochastic effects, or to other structuring factors has, however, been the subject of some debate (Weins 1977, Schoener 1982). Several hypothesis have been proposed to explain about the prey selection by the predators (Karanth and Sunquist 1995). These hypotheses pertain to ultimate causal factors such as energetic benefits and cost involved (Griffiths 1975, Stephans and Krebs 1987) as well as to proximate mechanisms of selection such as search images or prey vulnerability (Curio 1976, Taylor 1976, Temple 1987). Large carnivore prey selection can be expected to be a complex phenomenon (Bekoff *et al* 1984, Kruuk 1986, Sunquist and Sunquist 1989) spatial and temporal scales involved in predation studies preclude strictly experimental approaches in the field (Taylor 1984). Non experimental field studies of large carnivores have advanced understanding of prey selection (Erington 1967, Mech 1970, Hornocker 1970, Kruuk 1972, Schaller 1972, Curio 1976 and Taylor 1984). Recent studies have examined large carnivore predation in animal communities of temperate zone forests (Bergerud *et.al.* 1983, Messier 1991, Gasaway *et al* 1992, Huggard 1993) and of tropical savannas (Kruuk 1972, Schaller 1972, VanOrsdol 1982, Packer *et al* 1990, Prins and Lason 1989, Mills and Shenk 1992, Stander and Albon 1993, Scheel 1993). Terborgh (1990) has argued that large carnivores may play a relatively major role in shaping prey communities in the stable environments of tropical forests (Karanth and Sunquist 1995) and field studies of prey selection have been scarce in these habitats (Schaller 1967, Johnsingh 1983, Rabinowitz and Nottingham 1986, Emmons 1987, Rabinowitz 1989, Griffiths 1975). Large carnivore prey selection pattern in tropical forests are poorly understood (Karanth and Sunquist 1995).

2. Literature review

Tiger has been studied in its distribution range with respect to its general ecology, home range, habitat use, prey selection, conflicts with local people (Seidensticker *et al*. 1999). Different aspects of tiger conservation studied in Indian subcontinent are on general ecology (Schaller 1967, Johnsingh 1983, Seidensticker and McDougal 1993), social organization (Sunquist 1981), land tenure system (Panwar 1979, Smith *et al.* 1987, Gogate and Chundawat 1997, Vanak 1997), dispersal and communication (Smith 1984), its effect on prey species (Tamang, 1983, Karanth, 1993), prey selection (Karanth and Sunquist 1995, Biswas and Sankar 2002, Bagchi *et al.* 2003), food habits (Schaller 1967, Johnsingh 1983, Johnsingh *et al* 1993, Stoen 1994, Sankar and Johnsingh 2002), and tiger-leopard interaction (Seidensticker 1976). Besides these, lot of natural history accounts and some short term studies are also available *eg.* Corbett (1944), Mc Dougal (1977), Sankhala (1977), Singh (1984), Thapar, (1986, 1989). The above mentioned studies give an overview of tiger ecology from only some of the habitats where it occurs.

The leopard is found in almost every kind of habitat, from the rainforests of the tropics to desert and temperate regions (Kitchener 1991). Leopard is found throughout sub-Saharan Africa and Southern Asia with scattered population in China and North Africa (Scott 1988, Bailey 1993, Daniel 1996). The Indian race, *Panthera pardus fusca*, is distributed all over the country, being absent only in the arid deserts and above the timber line in the Himalayas (Prater 1980).

According to Hamilton (1976) the leopard had the reputation of being one of the least studied of the large carnivores despite being the most abundant. The situation is hardly different even now, especially in the Indian context. Most of the studies on leopards have been done in Africa (Hamilton 1976, Bertram 1982, Bailey 1993, Jenny 1996). The leopard studies in India gained momentum by 2000, addressing human leopard conflicts (Edgaonkar and Chellam 1998, Goyal and Chauhan 2006), general ecology (Qureshi and Edgoankar 2006 and Jamal A. Khan pers. comm.), population estimation (Mondal 2006) and food habits (Johnsingh 1983, Karanth and Sunquist, 1995, Daniel

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1996, Edgaonkar and Chellam, 1998, Sankar and Johnsingh 2002). The sparse information on leopards in Asia has mostly come from studies which had the tiger (Sunquist 1981, Karanth and Sunquist 1995) or lion (Chellam 1993) as the species of interest.

The increasing human population, changing land use practices, soaring demands from our urban population and more recently fast expanding economic activity have started straining the delicate balance at which tiger and leopard survive (Wickramanayake *et al* 1998). Tiger and leopard being a large territorial animal require large spaces and in small and isolated protected areas they frequently venture out and come in direct conflict with local people and experience high mortality. Fragmentation and loss of habitat and its quality usually result in loss of prey availability. Inadequate prey base affect tiger and leopard's reproductive success and their survival. More recently poaching for commercial use is a serious threat to tiger and leopard population (Kumar and Wright 1999).

The Asiatic wild dog or dhole (*Cuon alpinus*) is one of the most remarkable carnivores in the Asian jungles and least studied social carnivore in the world. Even in many of the well-protected reserves in the country, up-to-date scientific information on existing dhole populations remains negligible. Very few specific long-term studies have been conducted on this species (Johnsingh 1982, 1983, Venkataraman *et al* 1995, Acaharya *et al* 2006). To supplement the basic information given by earlier studies on dholes (Johnsingh 1982, 1983, Karanth and Sunquist 1995, Venkataraman *et al* 1995, Acaharya *et al* 2006), more information on inter-specific relationships competition and nich separation between dhole and other sympatric large carnivores, such as tiger and leopard, would be of relevant conservation value.

There have been relatively few studies on prey selection and food habits by sympatric carnivores carried in a tropical forest (Johnsingh 1983, Karanth, and Sunquist 1995). Behavioral factors that are likely to contribute to the coexistence of tiger, leopard and dhole, were investigated in the tropical forests of Nagarahole, Southern India (Karanth 1993, Karanth, and Sunquist 1995, 2000). The three predators selectively killed different

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prey types in terms of species, size and age-sex classes, facilitating their coexistence through ecological separation (Johnsingh 1992, Karanth, and Sunquist 2000). In the tropical forest habitats of southern Asia, tiger, leopard and dhole form a three-species predator assemblage over a large region (Karanth and Sunquist 2000). All three species are morphologically specialized for killing of prey larger than themselves; and in most places their prey base consists of cervids, bovids and suids. Tigers and leopards exploit this common suite of prey species as solitary, stalk-ambush hunters, whereas dholes are coursing pack hunters (Schaller 1967, Seidensticker 1976, Sunquist 1981, Johnsingh 1983, Karanth 1993).

The Mudumalai Tiger Reserve, Tamil Nadu offers excellent opportunity to study the ecology of sympatric carnivores. In order to understand the inter-specific relationships, competition and nich separation amongst tiger, leopard and dhole, the present study is proposed in Mudumalai Tiger Reserve. The study will have direct conservation value for the park management for managing the species and their habitats.

3. Objectives

1. To estimate density, distribution, group size and composition of prey species of sympatric carnivores (tiger, leopard and dhole).
2. To study the food habits and prey selectivity of sympatric carnivores.
3. To estimate the population of the sympatric carnivores.
4. To study the distribution of sympatric carnivores and their prey species with specific reference to anthropogenic pressure
5. To develop conservation action plan for these sympatric carnivores.

4. Study Period: Three years

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5. Study area

The study area Mudumalai Tiger Reserve (MTR) (11^0 20' & 76^0 45' N and $76^0$20'& $76^0$45' E) the newly created Tiger Reserve in the country since April 2007 is situated at the tri-junction of Tamil Nadu, Karnataka and Kerala states. It is contiguous with Wayanad wildlife Sanctuary on the west, Bandipur Tiger Reserve on the north and the south and east the Singara and Sigur Reserved Forests which forms the boundary of Nilagiri North Division. The MTR is located within the Nilgiri Biosphere Reserve. The Sanctuary was created in 1940, the first in southern India, with an area of 60 km^2. In 1956, it was enlarged to 295 km^2 and later to a further 321 km^2, which it is present extent. The Core Zone of this Sanctuary (100 km^2) has been notified as National Park. The present park was under the control of Thirumalapad kovilagam until late 18^{th} century and in 1914 this area was declared as Reserved Forests. This park has got five ranges (Mudumalai, Theppakadu, Kargudi, Masinagudi and Nelakottai), 18 beats and 35 forest compartments.

According to Champion and Seth (1968) the vegetation types found in Mudumalai are classified into Southern Tropical Dry Thorn Forest, Southern Tropical Dry Deciduous Forest, Southern Tropical Moist Deciduous Forest, Southern Tropical Semi Evergreen forest, Moist Bamboo Brakes and Riparian Forest. The terrain is undulating with an average elevation of 960 m to 1266 m. Moyar River and its tributaries drain the Tiger Reserve. The eastern part of Masinagudi range is flat in nature. Morgan betta of Masinagudi range is the highest peak (1266 m) in Mudumalai. Narathi betta on the western side of the park is the second highest peak (1188 m). The park areas located in Wayanad plateau is characterized by the presence of several swamps and `vayals' varying in size. The Moyar river, originating from Nilgiri Mountain near Pykara and meanders through the park for a distance of 20 km. Moyar River is the major water source for wildlife and people living in the park. Avarhalla is another perennial water source in the eastern part of Mudumalai. Seepage water from Maravakandy dam flows through Avarhalla through out the year. There are four major artificial waterholes in the park.

They are Ombetta, Game Hut and C3 (Compartment 3) check dam and Narathi check dam. Water is available for wildlife in these waterholes throughout the year. There are several seasonal waterholes present in the Tiger Reserve. The seasonal waterholes include Mavinhalla, Bidharhalla, Segur River, Doddakattihalla, Hebhalla, Imberhalla, Bennahole, Kekkanhalla, Mukkattihole etc.

The park has a long wet season and a short dry season. It receives rainfall from south west and north east monsoons. The south west monsoon start by May and ends by August while the north east monsoon starts by September and ends by December. Based on the climate of the area, there are three distinct seasons recognized: dry season (January to April) first wet season (May to August) and second wet season (September to December). The rain fall has a marked east-west gradient, with the eastern areas getting the least amount of the heaviest rains (1000 to 2000 mm). The temperature ranges from 8^0C in December to 35^0 C in April.

There are 21 tiny hamlets located within the park. It covers an area of 648.93 acres of patta land; lands under forest lease and assessed wasteland. People living in these settlements include 182 families of Mountadan Chetties, 22 families of Kattu Naickers and eight families of Paniar Tribes. Their main occupation is agriculture cattle rearing and the tribes work in the agriculture fields of Chetties and they also collect tubers and fish from the park for their sustenance.

There are also Kurumba and Paniya tribes living near Theppakadu, Kargudi and Thoraplli. The Kurumbas are basically hunter-gatherers. Now they do not hunt any animal but they collect tubers, mushroom and also scavenge carnivore kills.

Moyar is a non-tribal village located as an enclave in the eastern part of the park. This is basically a village with electricity board employees and a few resident Irula tribes, a grazier and agrarian tribal community. There are also retired electricity board employees settled in this village. The village has expanded in the last ten years by encroaching and clearing the revenue land adjacent to forest area. These villagers cultivate ragi, coconut,

garlic, cabbage, beans etc. These villagers own large number of unproductive scrub cattle.

There are quiet a few villages abutting the eastern and southwestern part of the park. They are Mavinhalla, Chemmanatham, Masinagudi, Bokkapuram, Singara, Thorapalli and Bospara to name a few. These villagers cultivate paddy, tapioca and raise plantations like tea, coffee and pepper. They own cattle and these cattle graze in the forest. In Masinagudi range, the Comparment # 12 is opened for grazing with permit and in other parts they graze illegally.

6. Methods

6.1 Vegetation and land cover mapping

Satellite Imagery (LISS IV data) for Mudumalai and adjoining areas will be procured from Indian Remote Sensing Agency. A false colour composite map of the study area will be generated using the satellite imagery. A detailed vegetation and land cover map of the study area will be developed after ground truthing. Vegetation of the study area in each habitat type will be quantified by stratified random sampling (Muller-Dombois and Ellenberg 1974). Random circular plots (10 m radius) will be used to evaluate vegetation community structure and composition.

6.2 Estimation of major prey species and sympatric carnivore population

Information on the availability of the prey species will be estimated through stratified random sampling in each major habitat types identified through the vegetation map. For this purpose, line transects will be laid in all major vegetation types in proportion to their availability. Along the line transects, population of prey species will be estimated by the Line Transect method (Burnham *et al* 1980, Buckland *et al* 1993, Khan *et al* 1995, Lancia *et al* 1994 and Karanth and Sunquist, 1995, Plumptre 2000, Biswas and Sankar

2002, Karant *et al* 2004, Sankar and Johnsingh 2002, Bagchi *et al* 2003, Stefando *et al* 2006). Each transect will be walked four to five times every season for two successive years and information on the number of animal seen, species, sighting angle, perpendicular distance, group size, and age structure and will be collected. This will provide data on the density, demography and distribution of prey species in the study area. The line transect data will be analysed using the software DISTANCE (Laake *et al* 1998). Information on health status of prey species in different seasons will be collected by sampling > 30 groups of each prey species.

The camera traps (n=40 pairs) will be placed in 2x2 km grid covering a sample block of approx 150 sq.km and monitored during winter and summer for two successive years. Attempt will be made to photograph the target species tigers, leopards and wild dogs present in the intensive study area based on the stripes, spots on their flanks and other individual identification characteristic features, such as wounds, scares, cut ear, cut tail etc. An appropriate mark recapture model will then be applied to estimate the large carnivore population (Otis *et al* 1978, White *et al* 1982, Karanth and Nichols 2002, Jennelle *et al* 2002, Gilpin and Soule 1986, Karanth 2006).

Track plots will be laid along trails in each habitat type and monitored at regular intervals. An index of relative abundance obtained as the percent of times pugmarks are seen on track plots will be calculated. The index will be compared with the densities of large carnivores obtained using camera traps in these habitat types. A section of trail will be monitored in each habitat type. The length of the trail will be proportional to the area of the habitat type. The number of tracks and scrapes made by tigers, leopards and wild dogs per kilometer of trail will then be used as an index and correlated with large carnivore densities (Jhala *et al* 2007) (Program PRESENCE- MacKenzie 2002, MacKenzie 2003).

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6. 3 Food habits

Diet and food preference of tiger, leopard and wild dog will be estimated from the scat analysis and from the kills (Reynolds and Aebischer 1991, Mukherjee *et al* 1994, Biswas and Sankar 2002, Sankar and Johnsingh 2002, Bagchi *et al* 2003). Scats of all carnivores will be collected from the entire study area through out the year. The scat will be collected from road, trail and transect. The design will be stratified and systematic to have the goal spatial coverage. All the scats will be washed and oven dried and will be preserved for future analysis. Prey items such as hairs and bone will be used to identify the prey species. For this, micro-histological structure of hairs will be used to identify the prey species (Schaller 1967, Sunquist 1981, Johnsingh 1983, Karanth and Sunquist 1992, Mukherjee *et al* 1994, Biswas and Sankar 2002, Sankar and Johnsingh 2002, Bagchi *et al* 2003). The following information will be collected on each kill: age, sex and general health condition of the prey species by assessing their bone marrow conditions. The kill locations will also be evaluated to determine the characteristics of the preferred kill sites.

Carbone and Gittleman (2002) opined that prey-predator relationship follow a general model, the carnivore number per unit prey productivity scales to carnivore mass near -0.75. The scaling equation can provide theoretical background for evaluating prey selection models.

6.3.1 Estimation of biomass and number of prey consumed by tiger, leopard and wild dog from scat analysis using a correction factor.

The biomass and number of individuals of the prey consumed by tiger, leopard and wild dog will be estimated using Ackerman's equation (Ackerman *et al* 1984) to get a more accurate estimate of prey consumption (Karanth and Sunquist 1995, Biswas and Sankar 2002, Sankar and Johnsingh 2002, Bagchi *et al* 2003).

$Y = 1.980 + 0.035X$, where X = average weight of a particular prey type and Y = Kg of prey consumed per field collectible scat (Ackerman *et al* 1984).

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The assumption for extrapolating of the above equation is that the tiger, leopard and wild dog and cougar (*Felis concolor concolor* **Linnaeus**) have similar utilization and digestibility. We presume that the scats containing various prey items have similar decay rate and their detection is equally probable and would apply the same formula as mentioned above (Ackerman *et al* 1984) to estimate the prey consumption by these sympatric carnivores.

6.3.2 Estimation of prey selectivity.

Prey selectivity by tiger, leopard and wild dog will be estimated for each species by comparing the proportion of prey species utilized from scats with the expected number of scats in the environment for each of the prey species consumed. Frequencies of the identifiable prey remains in the scat do not tell us about the actual proportion of prey type eaten. This is more so when the prey types vary in size to a considerable degree. Smaller prey species have more undigested material (i.e. hair) due to higher body surface to mass ratio. Hence, intake of smaller body sized prey induces relatively more amount of scats production per unit mass of prey consumed leading to an over estimation of smaller prey species in the diet studies of carnivores (Ackerman *et al* 1984). Correction factor developed by Ackerman *et al* (1984) from feeding studies on cougar will be used to estimate the relative proportion of biomass of prey consumed by the sympatric carnivores during the present study. Application of this regression equation for tiger, leopard, and wild dog involves assuming similar carcass utilization and comparable digestive system of cougars with tigers, leopards and wild dogs.

Prey selectivity by tiger, leopard and wild dog will be estimated for each prey species by comparing their availability and utilization data. The expected proportion of scats in the environment (i.e. availability) will be calculated using the following equation (Karanth and Sunquist 1995):

$fi = [(di /dt) * \lambda i]/ \Sigma [(di/dt) * \lambda i]$, where fi= expected scat proportion in the environment, di= density of i th species, dt = sum of density of all species, $\lambda i = X/Y =$

the average number of collectible scats produced by leopard from an individual of i th prey species, X = average body weight of the species and Y = 1.980 + 0.035 X.

Multinomial likelihood ratio test will be used to evaluate prey selection of these carnivores in the study area (Chesson 1978, Manly *et al* 1972, Reynolds and Aebischer 1991, Link and Karanth 1994, Karanth and Sunquist 1995). The exact variability of prey items in scats is not known and in order to account for that, sensitivity analysis will be done by changing coefficient of variance from 10 to 40% (Link and Karanth 1994). Program Scatman (Link and Karanth 1994) will be used to do multinomial test and sensitivity analysis by bootstrapping data 5000 times. To understand the effect of body weight, prey dispersion and group size on prey selection, partial correlation will be done, controlling for prey availability.

6.4 Distribution of sympatric carnivores and their prey species with specific reference to anthropogenic pressure

The data on sympatric carnivore locations based on direct and indirect evidences (camera traps, track plots), prey species distribution and abundance from line transect will be registered in the Geographical Information System (GIS) domain. In addition, anthropogenic data (wood cutting, lopping, grazing, (0 to 4 scale:- 0: none, 1: less than 25%, 2: 25 to 50%. 3: 50 to 75%, 4: >75%) livestock dung, minor forest produce collection etc.,) will be collected from every 200 m sampling point around 10 m radius along the line transects in all beats during all seasons for two successive years. These different layers will help in generation of the maps for the large carnivore movement and distribution of its prey species with response to anthropogenic pressure in the entire park. Information on human-large carnivore conflicts will be collected from all villages in and around the park through a structured questionnaire once a year. All available secondary information from the park authorities regarding the human-large carnivore conflicts will also be collected. Sequentially all the layers (village location, anthropogenic pressures, human and livestock trails, carnivore distribution, water availability, prey species

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distribution and abundance, human-carnivore conflict areas) will be used in delineating the areas with different levels (ranging from high to low category) of anthropogenic pressures and also the zones (ranging from no to high category) with human-carnivore conflicts. The habitat suitability model (ENFA- Olivier and Wotherspoon 2006 and Hirzel *et al* 2001) and landscape level meta population viability approach (Ramas GIS-Larson *et al* 2004 and Haines *et al.* 2006) will be used to develop a conservation action plan for sympatric carnivores. The Habitat Suitability maps are commonly built on presence/ absence data (e.g. logistic regression. discrimanat analysis etc) and will be developed using the Ecological Niche Factor Analysis (ENFA) on environmental data and species distribution data.

7. Expected out come.

The outcome of the proposed study would reveal information on the sympatric carnivore's status, distribution, population, availability of prey species, habitat use, and food habits which in turn will make us understand their ecological separation. The GIS map outputs that will be generated on sympatric carnivores and their prey species distribution with specific reference to anthropogenic pressure zones will be of immense use for the park management to effectively manage the habitats for tiger, leopard and wild dogs in Mudhumalai Tiger Reserve and surrounding areas.

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Task responsibilities of the Investigators

Sl. No	Name	Task Responsibilities
1.	Dr. K. Sankar	Overall project co-ordination, field inputs, predator population estimation, prey abundance sampling design, data analysis, submission of periodical reports and final project report.
2.	Mr. Qamar Qureshi	GIS application, overall study design, field inputs, data analysis, submission of periodical reports and final project report.

PROPOSED BUDGET

S. No.	Budget Head	Year 1 Rs.	Year 2 Rs.	Year 3 Rs.	Total Amount (Rupees)
1.	Engagement of one Junior Research Fellows (JRF) @ Rs. 8,000/- for 2 years and @ Rs. 9,000/- for the third year as Senior research Fellows (SRF) Engagement of one Technical Assistant (TA) @ Rs. 6,400/- for 3 years	96,000 76,800	96,000 76,800	1,08,000 76,800	3,00,000.00 2,30,400.00
2.	Engagement of 3 field assistants @ Rs. 3000/- per month	1,08,000	1,08,000	1,08,000	3,24,000.00
3.	Engagement of 1 driver @ Rs. 3000/- p.m	36,000	36,000	36,000	1,08,000.00
4.	TA/DA for Researchers	20,000	20,000	20,000	60,000
5.	TA/DA for the P.I's	80,000	80,000	80,000	2,40,000
6.	Insurance liability to researchers and field assistants and driver	6,000	6,000	6,000	18,000
7.	Hiring of accommodation @ Rs. 1000/- per month	12,000	12,000	12,000	36,000
8.	Hiring of one four wheel drive vehicle, and P.O.L.	3,00,000	3,00,000	2,00,000	8,00,000
9.	Communication costs (telephone, courier, fax, e-mail,	5,000	5,000	5,000	15,000

S. No.	Budget Head	Year 1 Rs.	Year 2 Rs.	Year 3 Rs.	Total Amount (Rupees)
	postal charges)				
10.	Purchase of satellite imagery, map outputs and reproduction of reports	75,000	-	-	75,000
11.	Purchase of 80 Deer Cam cameras, 2 binoculars, 2 GPS, 2 Range Finders, 1 Densiometer, Thermometer, Hygrometer and other field equipments.	4,00,000	-	-	4,00,000
12.	Purchase of a note book computer, printer & UPS for the field station	100,000	-	-	1,00,000
13.	Contingencies, stationary, film rolls, film processing, etc.	50,000	50,000	50,000	1,50,000
14.	Participation in national and international seminars/workshop/conference	1,00,000	1,00,000	1,00,000	3,00,000
	Yearly Total	**14,64,800**	**8,89,800**	**8,01,800**	**31,56,400**
	10% cost escalation per year	1,46,480	88,980	80,180	3,15,640
	Grand Total	**16,11,280**	**9,78,780**	**8,81,980**	**34,47,040**

(Rupees Thirty Four Lakhs Forty Seven Thousand Forty only)

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Proposed Work Plan

S.No.	Activities	1 Year	2 Year	3 Year
1.	**Preparatory Activities (purchase of equipments, recruitment of researchers, initiation of field work)**	*		
2.	**Field Work**	*	*	
3.	**Data Analysis**	*	*	*
4.	**Annual Report**	*	*	*
5.	**Final Report**			*

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